A New Species of *Sparganothis* Allied to *S. pettitana* (Rob.), with Descriptions of Larvae and Adults of Both Species (Lepidoptera: Tortricidae)[1]

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Introduction

Two species of tortricid larvae, which were easily separated by appearance and by host, were reared by the author during the summer of 1951. Identification of adults showed that two species of *Sparganothis* had previously been associated with the name *Sparganothis pettitana* (Robinson). The true *S. pettitana* was identified by comparison of a series of male adults of both species with the illustration accompanying the original description (Robinson, 1869, Pl. IV) and with Type No. 7417 in the Brackenridge Clemens Memorial Collection at the Academy of Natural Sciences, Philadelphia, Pa.

Descriptions of the larvae and adults of both species are given herein. Though no difference in setal pattern of the segments of the larvae could be discovered, setal maps have been included with the illustrations; the system followed in naming the setae of the segments is that of Fracker (1915), and of the head, that of Heinrich as cited by Peterson (1948). *Tobacco Cutworms* by Crumb (1929) was a very useful reference for the morphology of the larvae, and the unpublished thesis by R. Lambert (1950) for that of the adults.

Sparganothis pettitana (Robinson)

First instar (Figs. 7 and 16).—(Three head capsules observed). Head capsule dark brown; length of median dorsal line from anterior edge of postclypeus posteriorly to termination of adfrontal sutures: .26±mm. Mandible with five teeth, the first three large and sharply pointed, the fourth small and pointed, the fifth small and rounded; internal ridges from first two or three teeth to dorsal area near mandibular socket.

Second instar (Figs. 8 and 17).—(Four head capsules observed). Head capsule dark brown; length of median dorsal line from anterior edge of postclypeus to termination of adfrontal sutures: .45±mm. Mandible as in first instar but larger.

Third instar (Figs. 9 and 18).—(Five head capsules and one larval skin observed). Head capsule dark brown; length of median dorsal line from anterior edge of postclypeus to termination of adfrontal sutures: .75±mm. Mandible with fifth tooth becoming ridge-like; ridge leading from first tooth no longer concave and middle portion developing into internal tooth or retinaculum. Prothoracic shield, areas surrounding Kappa and Pi setal groups on prothorax, and thoracic legs sclerotized and brown. Body whitish. Integument finely spinulated, spinules inconspicuous.

Penultimate instar.—(Two specimens possibly of this instar observed). Apparently little different from larvae of third instar except in size. Darker mark-

ings of prothoracic shield of last instar becoming apparent on a somewhat paler prothoracic shield.

Ultimate instar (Figs. 1 and 6, cf. Figs. 11, 21-23).—Average length: 25 mm.; average head width: 1.8 to 1.9 mm.; average length of median dorsal line from anterior edge of postclypeus to termination of adfrontal sutures: $1.3 \pm$ mm. Integument finely spinulated; spinules slender, inconspicuous. Body green or yellowish-green; setal bases except those of prothorax, on slightly raised areas that are lighter than body in colour. Setae long. Spiracles circular, dark-rimmed, pale-centred.

Head usually tan with dark-brown lateral bars and ocellar areas; tan colour sometimes overlaid with a dark-brown pattern with bar and ocellar area joined; occasionally head entirely dark brown, almost black. Anterior seta 2 (A_2) closer to A_1 than to A_3 and at the apex of a triangle formed by these three setae. Ocellus II closer to ocellus III than to ocellus I or equidistant from both. Median longitudinal width of postclypeus about equal to that of preclypeus. Width of labrum (cf. Fig. 13) one and three-quarters or more times length; sides of notch on anterior margin forming an angle of $75 \pm °$.

Mandible (cf. Fig. 20) with five teeth, the first four blunt, the fifth straight-edged; retinaculum, in the form of a broad ridge, well developed from middle third of internal ridge which extends from first tooth to dorsal area about mandibular socket.

Spinneret (cf. Fig. 12) rounded at tip; as long as or longer than labial palp, length four and three-quarters or five times width. Free margin of blade of maxillula crenate, with about six rounded teeth posteriorly, and edged anteriorly with fifteen or more small, sharp teeth, which are isolated in arrangement; lobes clothed with small spines directed mesocaudally; gorge armed with minute spines, which are apparent only under high magnification.

Prothoracic shield sclerotized, usually of body colour with two distinct brown or blackish V markings posteriorly, one on either side of middorsal line; shield sometimes with some irregular darkening of sclerotin toward posterior and/or lateral edge. Prothoracic Kappa and Pi groups of setae on raised areas that are lightly sclerotized and also of body colour; middle seta of Kappa group ventrad of or in horizontal line with other two; occasional specimen with some brownish sclerotization of raised areas.

Pi group of setae on mesothorax and metathorax unisetose, on seventh abdominal segment trisetose, on eighth abdominal segment bisetose.
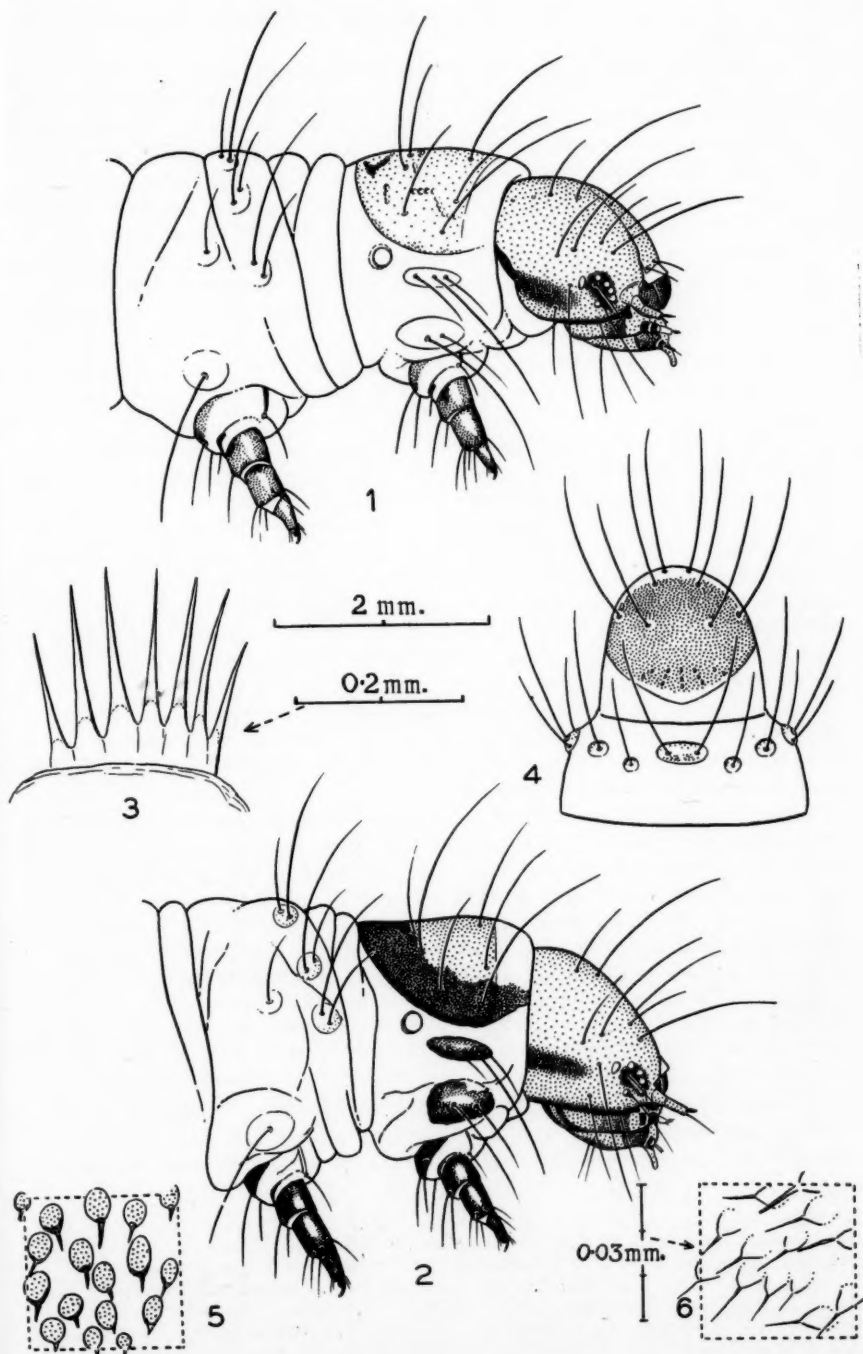
Anal shield of body colour. Anal fork slender; prongs usually seven in number, sometimes more, often less.

Thoracic legs brown to dark brown. Ventral and anal prolegs of body colour; crotchets (cf. Figs. 14 and 15) uniserial and triordinal; crotchets of ventral proleg of sixth abdominal segment $60 \pm$ or $65 \pm$, those of anal proleg $45 \pm$ in number.

Hosts.—Basswood. Occasional specimens have been recorded from American elm, white elm, alder, trembling aspen, ironwood, sugar maple, and red oak; however, since last-instar larvae and pupae have been collected on mountain maple and hazelnut that were growing adjacent to basswood trees on which larvae and

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Figs. 1 and 6. *S. pettitana* (Rob.). 1, head, prothorax, mesothorax; 6, integument highly magnified, showing spinules.

Figs. 2-5. *S. acerivorana* n. sp. 2, head, prothorax, mesothorax; 3, anal fork; 4, abdominal segments 9 and 10; 5, integument highly magnified, showing spinules.

pupae were also found, most of such records can probably be explained by similar occurrences.

Remarks.—Larvae of *Archips rosaceana* Harris may often be found feeding on basswood along with larvae of *S. pettitana*. Young larvae, even those of the first instar, may be separated by the mandible, which in *A. rosaceana* has a small tooth at the base of the first tooth on the curved ridge from the latter to the dorsal area about the mandibular socket.

The head capsules of first-, second-, and third-instar larvae were found in rolled leaves within which the later-instar larvae were still feeding.

The pupa is found in a rolled leaf, or sometimes in a small purselike structure that is itself within a large pouch formed by the remainder of the leaf. Pupation requires about seven to ten days, and the adults usually emerge during the latter half of June and early July.

Adult (Figs. 27, 28, 29).—Average wing expanse of 20 reared males: 21.6 mm., and of 20 reared females: 26.9 mm.; specimens caught in flight somewhat larger.

Male with dorsal area of labial palp, head, thorax, and anterior wing barium yellow (Ridgway, 1912) to very pale yellow; ventral and outer areas of labial palp and maculation of anterior wing reddish-brown. Horseshoe-shaped tuft on front of head reddish-brown, Tegula yellow with reddish-brown scales at base. Anterior wing with an oblique fascia from basal third of costa directed toward middle of dorsal margin but ending approximately halfway; aggregations of reddish-brown scales at apical third of costa, and at base of costa, the latter a continuation of reddish-brown scales at base of tegula; underside white with some pale reddish-brown scaling along costa. Posterior wing and cilia shining white, and abdomen white.
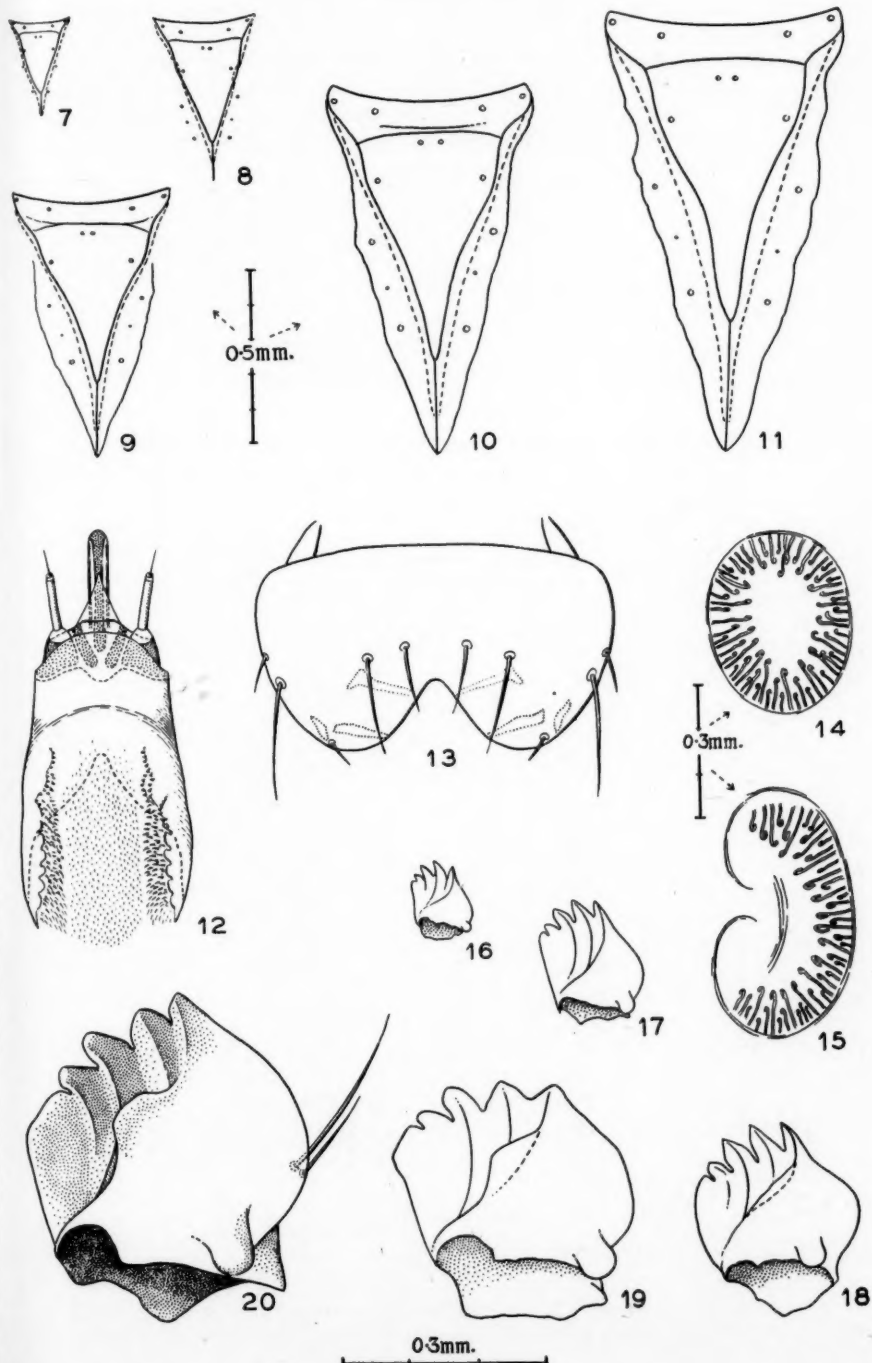
Female with head (including tuft on front), thorax, and anterior wing very pale yellow to shining white; some reddish-brown scaling on labial palp and at bases of costa and tegula; anterior wing almost always immaculate; posterior wing shining white and abdomen white.

Male Genitalia (Figs. 26 and 33).—Valve wide at base, long, rounded at apex; labis wide at base of valve, broadly triangular; sacculus extended to middle of or beyond ventral margin of valve. Anellus a subrectangular plate considerably broader posteriorly than anteriorly; posterior edge convex for most part, concave in middle. Aedoeagus slender, strongly curved, bluntly pointed; vesica armed with eight cornuti, which are a little more than one-third as long as aedoeagus and are attached near anterior ends by lateral projections. Vinculum U-shaped. Transtilla a band arched ventrally at middle to support a number of short, stout spines. Gnathos composed of two arm-like structures. Socii long and wide, length a little more than twice breadth. Uncus long and thin, furcate at base, usually extended beyond socii before curving ventrally to apex.

Female Genitalia.—Ovipositor lobes long, flattened, broadened distally. Genital plate broad with a nearly straight base and curved sides, strengthened ventrally with a crescent-shaped area. Distal end of ductus bursae cup-shaped,

Figs. 7-9, 16-18. *S. pettitana.* 7, postclypeal, frontal, and adfrontal areas, 1st instar; 8, postclypeal, frontal, and adfrontal areas, 2nd instar; 9, postclypeal, frontal, and adfrontal areas, 3rd instar; 16, mandible, 1st instar; 17, mandible, 2nd instar; 18, mandible, 3rd instar.

Figs. 10-15, 19, 20. *S. acerivorana.* 10, postclypeal, frontal, and adfrontal areas, penultimate instar; 11, postclypeal, frontal, and adfrontal areas; 12, hypopharynx (somewhat foreshortened), spinneret, and labial palp; 13, labrum; 14, crotchets of sixth ventral proleg; 15, crotchets of anal proleg, ultimate instar; 19, mandible, penultimate instar; 20, mandible, ultimate instar.
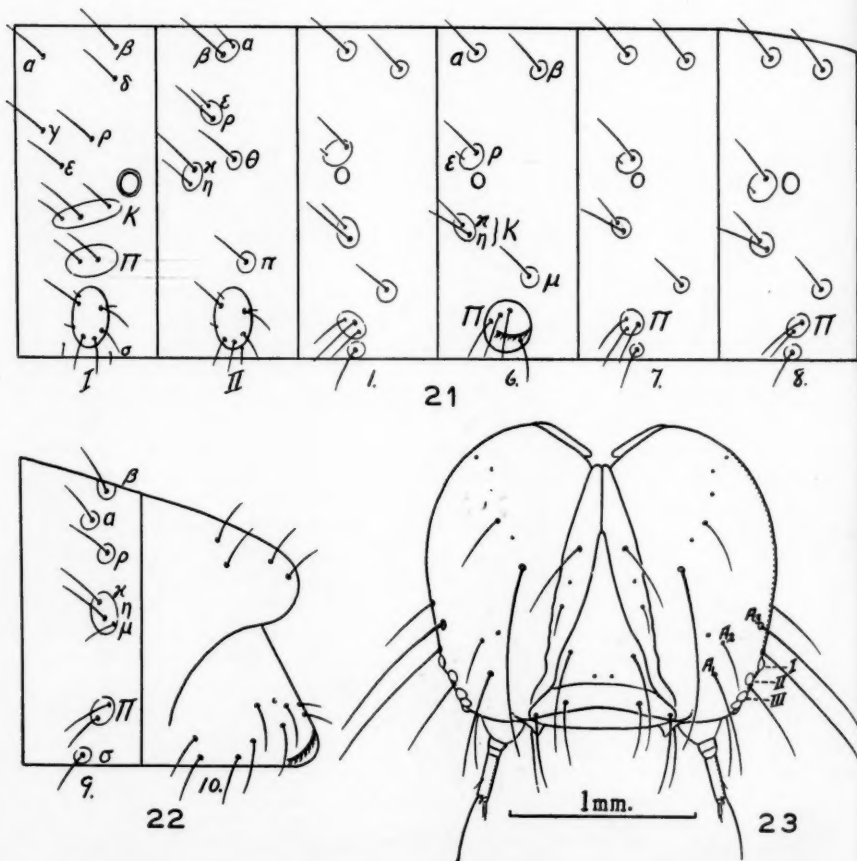
0·5mm.

0·3mm.

0·3mm.

lightly sclerotized, hooded dorsally over ventral ostium, and forming lateral lobes that are covered with short spines; remainder of ductus bursae membranous except for a sclerotized ring near distal end, anterior half somewhat broadened and convoluted. Inception of ductus seminalis at anterior end of sclerotized ring. Bursa copulatrix large, more or less rounded; signum a long, twisted, bar-like structure on side of bursa near entrance of ductus bursae.
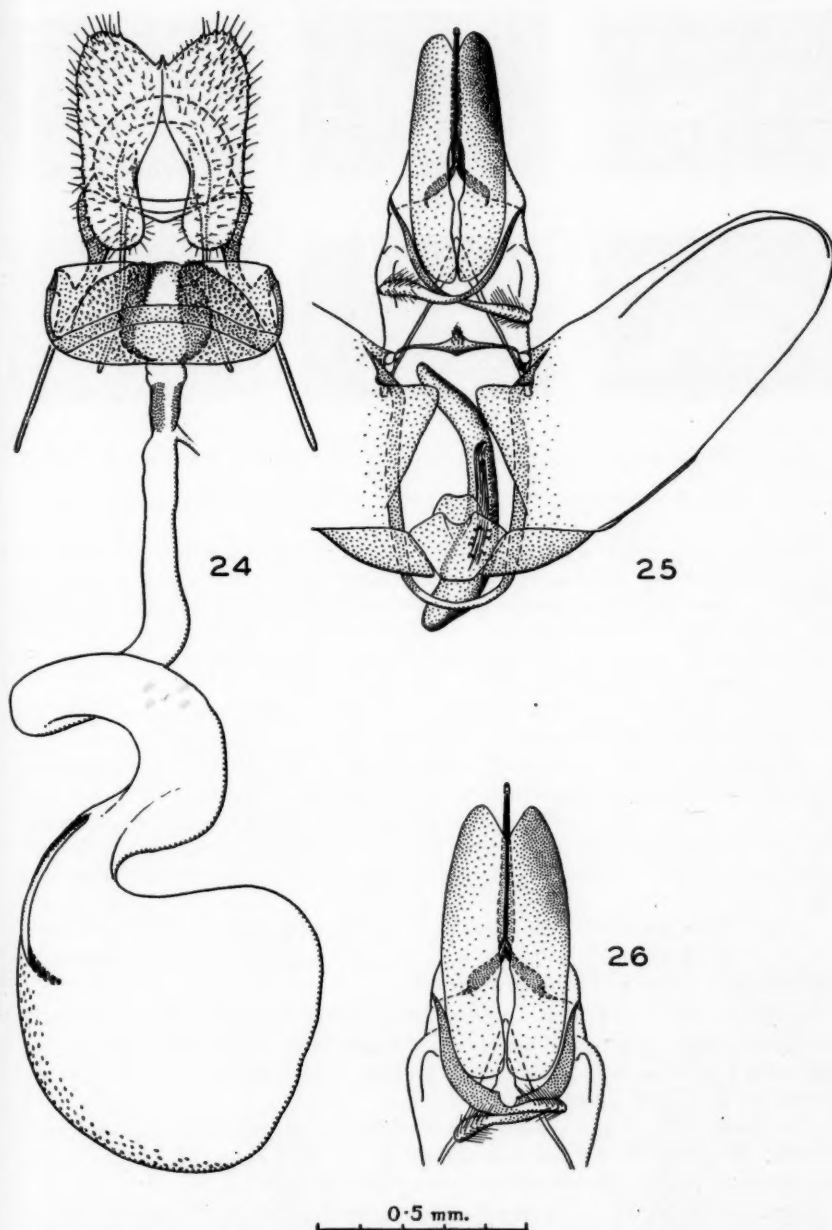
Sparganothis acerivorana n. sp.

Penultimate Instar (Figs. 10 and 19).—(Two head capsules and one skin observed). Apparently not different from larvae of ultimate instar except in size. Average length of median dorsal line from anterior edge of postclypeus to termination of adfrontal sutures: $1.05 \pm$ mm.

Ultimate Instar (Figs. 2-5, 11-15, 20, and setal maps 21-23).—Average length: 21 mm.; average head width: 1.8 to 1.9 mm.; average length of median dorsal line from anterior edge of postclypeus to termination of adfrontal sutures:

Figs. 21-23. *S. acerivorana.* 21, setal map of first and second thoracic segments and 1st, 6th, 7th, and 8th abdominal segments; 22, setal map of 9th and 10th abdominal segments; 23, setal map of head capsule.

0·5 mm.

Figs. 24 and 25. *S. acerivorana*, 24, allotype, female, genitalia; 25, holotype, male, genitalia. Fig. 26. *S. pettitana*, socii and uncus.

27   28   29

30   31   32

Figs. 27-29. *S. pettitana.* 27, male specimen from which Fig. 26 was made; 28, male; 29, female.

Figs. 30-32. *S. acerivorana.* 30, holotype, male; 31, male; 32, allotype, female.

1.3±mm. Integument finely spinulated; spinules apparently more numerous than in *S. pettitana*, shorter, and stouter; minute papillae on which spinules are set, darker than rest of integument. Body usually dirty green or yellowish-green, the impure colour being caused by the pigmentation of the papillae; setal bases, except those of prothorax, on slightly raised areas that are lighter than body in colour. Setae and spiracles as in *S. pettitana.*

Head, positions of setae and of ocelli, postclypeus, preclypeus, labrum, mandible, and hypopharynx as in *S. pettitana.*

Prothoracic shield usually tan, edged with a broad dark-brown band of pigment; distinctive; occasionally entirely dark-brown or almost black when head also dark. Prothoracic Kappa and Pi groups of setae on raised areas heavily pigmented with dark-brown; pale area above nu seta of Pi group usually present as illustrated; middle seta of Kappa group ventrad of or in horizontal line with other two.

Pi group on mesothorax, metathorax, and abdominal segments as in *S. pettitana.*

Anal shield usually grey or dark-grey and conspicuous, but sometimes of body colour. Anal fork as in *S. pettitana.*

Thoracic legs dark brown. Prolegs and crotchets of prolegs as in *S. pettitana.*

Hosts.—Sugar maple, red maple, silver maple, mountain maple. One or two specimens have also been recorded from white elm and basswood by Ottawa officers of the Forest Insect Survey.

Remarks.—The pupae are almost always found in purse-like structures such as those in which *S. pettitana* is sometimes found. Dates of pupation and emergence of adults correspond to those of *S. pettitana.*

Adult (Figs. 30, 31, 32).—Average wing expanse of 20 reared males; 21.8 mm., and of 20 reared females: 23.8 mm.; specimens caught in flight somewhat larger; females more variable in size than those of *S. pettitana.*

Male with dorsal area of labial palp, head, thorax, and anterior wing citron yellow (Ridgway, 1912); ventral and outer areas of labial palp, and maculation of anterior wing reddish-brown; maculation more variable and more nearly
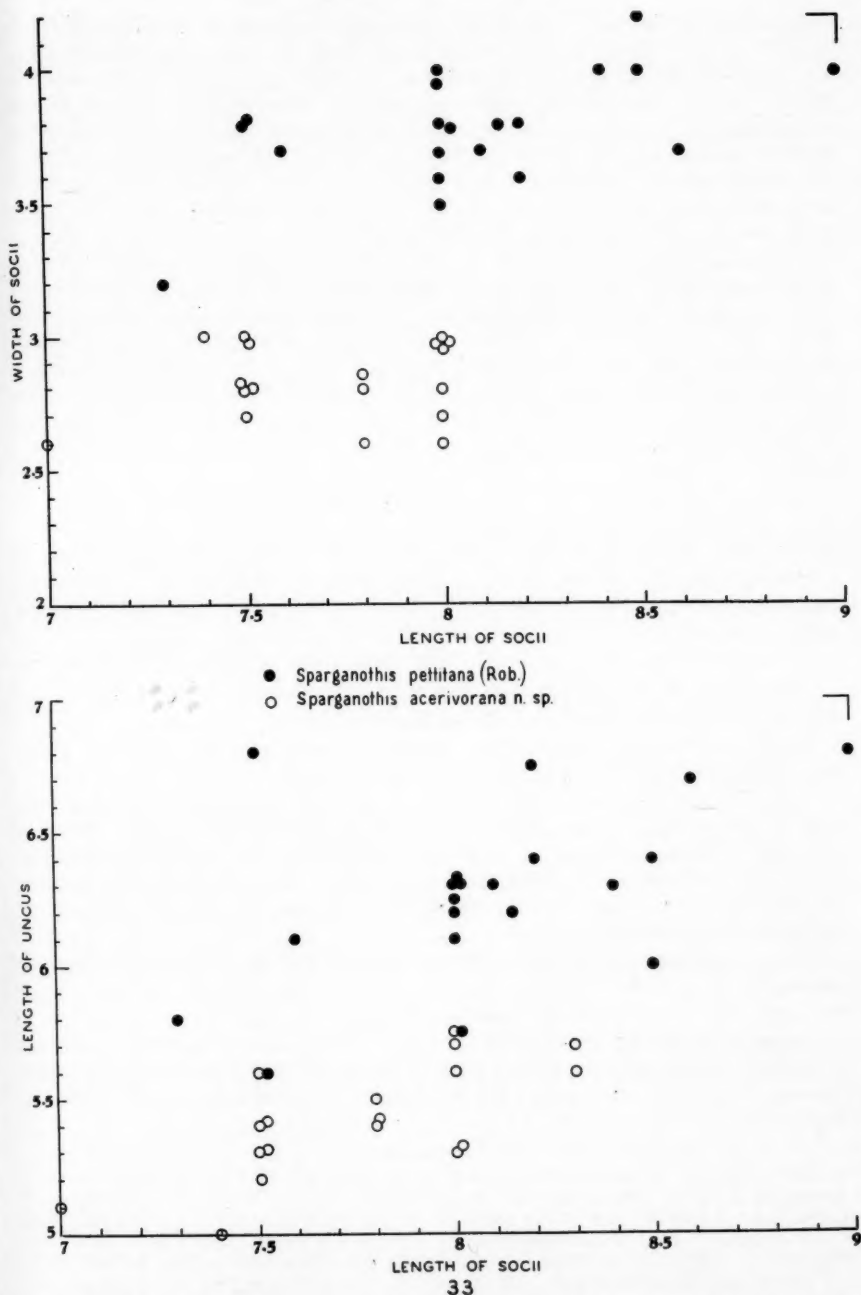
Fig. 33.   The relationships of width of socii and length of uncus to length of socii for each of *S. pettitana* and *S. acerivorana* (measurements relative).

complete than that of *S. pettitana*. Horseshoe-shaped tuft on front of head reddish-brown. Anterior wing with oblique fasciae from basal third of costa to middle of dorsal margin and from apical third of costa toward tornus; a reddish-brown terminal line usually apparent in some degree and aggregations of reddish-brown scales present at bases of costa and tegula; a few specimens barium yellow with indistinct maculation, others with considerable suffusion of reddish-brown scaling over entire wing, giving it a reticulate appearance; underside white with some pale reddish-brown scaling along costa. Posterior wing and cilia shining white; abdomen white.

Female with anterior wing barium yellow to white and, unlike that of *S. pettitana*, almost always with some reddish-brown maculation; also unlike those of *S. pettitana*, females with white anterior wings usually with dorsal area of labial palp and head, including tuft, citron yellow; other specimens with dorsal area of labial palp, head, thorax, and tegula the same colour as anterior wing; a few specimens with considerable suffusion of reddish-brown scaling over entire wing as in male. Some reddish-brown scaling on ventral area of labial palp, and at bases of tegula and costa as in male. Posterior wings shining white; abdomen white.

Male Genitalia (Fig. 25 and 33).—Unlike those of *S. pettitana* in shape of socii, and usually in length of uncus. Length of socii two and one-half to three times width; lateral edges more nearly straight than in *S. pettitana*, resulting in a somewhat smaller, neater, more compact structure than that of *S. pettitana*. Length of uncus usually shorter in relation to length of socii than in *S. pettitana;* apex of uncus usually only slightly beyond socii.

Female Genitalia (Fig. 24).—No differences found to separate the two species.

Holotype, Male.—Kingsmere, Quebec; rearing no. 88b, 6-VII-51, M.M.; No. 5983 in the Canadian National Collection, Ottawa.

Allotype, Female.—Meach Lake, Quebec; rearing no. 58a, 26-VI-51, M.M. No. 5983 in the Canadian National Collection, Ottawa.

Paratypes.—Kingsmere, Quebec: 7 ♂ ♂, 88a, 88d, 88e, 88g, 88A, 88Ab, 89, and 4 ♀ ♀, 88f, 88Aa, 88Ac, 88Ad. Meach Lake, Quebec: 2 ♂ ♂, 58b, 73D, and 1 ♀, 73C. Ottawa, Ontario: 2 ♂ ♂, 51, 55, and 1 ♀, 19. George's Lake, Ontario: 3 ♀ ♀, 48, F.I.S. Nos. 051-398A, and 051-398A₁. All specimens collected by M. MacKay except those from George's Lake collected by Ottawa personnel of the Forest Insect Survey.

Types and paratypes have been deposited in the Canadian National Collection, Ottawa.

Acknowledgment

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The Specific Status of *Aedes pionips* Dyar (Diptera: Culicidae)[1]

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The status of the mosquito *Aedes pionips* Dyar, 1919, has so far remained in doubt. The original description says in part, "Similar to *lazarensis* F. & Y. [=*communis* (Deg.)][3] but larger and more heavily marked." Of the larva Dyar wrote, ". . . head hairs in fives; other characters essentially as in *lazarensis*."

In 1928 Dyar wrote, "Where the two occur together, as is frequently the case, the *communis* are all out of the pools weeks before the *pionips* have matured." Also, "This [*pionips*] is a derivative species of *communis*, but quite distinct." In his keys he separated the females by colour and the larvae by numbers of head hairs; the males were not separated.

Edwards (1921) wrote, "The American forms *A. lazarensis* [=*A. communis* (Deg.)][3] and *A. tahoensis*, and probably also *A. pionips*, differ in such minute details that they can hardly be ranked as more than varieties of *A. communis*." In 1932, however, he listed *pionips* and *communis* separately and apparently regarded them as distinct species. Martini (1931) included *pionips* as a doubtful synonym of *nemorosus* [=*communis* (Deg.)][3].

Matheson (1929) considered *pionips* too rare to be included in his treatment of the North American species of *Aedes*. In 1944 he included it but wrote, "*A. pionips* is probably only a variety of *A. communis*. The genitalia of the males appear identical, and the adults are almost impossible to separate. The larvae are readily separated on the dorsal head hairs which are single in *communis* and multiple in *pionips*."

Gjullin (1946), in his key to the females of *Aedes*, included *pionips* and *communis* as distinct species and used the colour of the mesonotum to separate them. Rempel (1950) gave the formulae for the first three prothoracic hairs of the larvae—2, 1, 1 in *communis*, 1, 1, 1 in *pionips*—but did not indicate whether or not the character was useful in identifying specimens.

The differences between the two forms recorded up to the present are: in the larva, differences in numbers of head hairs, in numbers of prothoracic hairs, and in rate of development; in the female, differences in size and in the colour of the mesonotum; in the male, no difference.

Several hundred specimens of *communis* and *pionips* taken in the Northern Insect Survey, sponsored by the Department of Agriculture and the Department of National Defence, have been examined. A large number of these were individually reared and are associated with larval skins, others are from mass rearings, and the remainder were captured in the field. These specimens show enough constant differences between the two forms to indicate that they are distinct, although very closely related, species.

The main differing characters to be added to those mentioned above are: in the larva, shape of the outer comb scales and relative size of the first three prothoracic hairs; in the female, shape of the tarsal claws; in the male, shapes of the claspette filament and basal lobe of the genitalia, of the palpi, and of the hind tarsal claws.

Larvae.—The upper and lower head hairs of *pionips* have 3 to 6 branches; the head hairs of *communis* are always single. In *pionips* the first three pro-
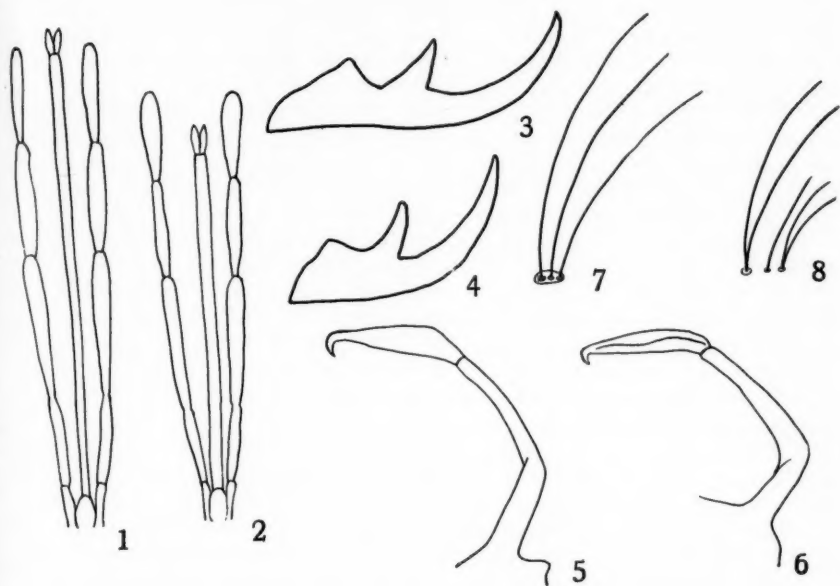
thoracic hairs (cf. Rempel, 1950) are single, heavy, and of equal length (Fig. 7); in *communis* the formula is 2, 1, 1 or 2, 1, 2, but the second and third hairs are very fine and only about half as long as the first (Fig. 8). The comb scales of the two species are very similar, but in *pionips* the scales near the edge of the patch are regular in shape; in *communis* they are usually slightly misshapen and are much less regular in outline than the scales in the centre of the patch. When the two species occur in the same pool, *communis* does emerge earlier than *pionips*, as Dyar pointed out; this may be due to an earlier hatching of the eggs, to more rapid larval development, or to both. At Norman Wells, N.W.T., *communis* emerged from one pool from June 11 until June 21, with very little emergence after June 18; *pionips*, from the same pool, from June 19 until June 21; emergence may not have been complete then, but the records go no further. Records are available for two pools at Yellowknife, N.W.T.: Pool A, *communis* from June 13 until June 22, *pionips* from June 27 until June 30; Pool C, *communis* from June 23 until July 11, *pionips* from July 2 until July 15.

Females.—The colour pattern of the mesonotum can be used to separate almost all specimens of these species. In *pionips* the sides of the mesonotum are yellow; the two central stripes are very dark brown, and separated from one another by a very narrow line of yellow scales that is sometimes almost absent; the two stripes are narrowed on either side of the greyish-yellow prescutellar area, but reach back to the scutellum. Laterally, the posterior half of each central stripe is separated by a narrow line of yellow scales from a dark-brown longitudinal line that extends from the mid line of the mesonotum to the scutellum. This pattern shows almost no variation in specimens taken throughout northern Canada. Dyar (1920) recorded *pionips* with a grey mesonotum from Atlin, B.C.; I have seen none of these and they may be of another species. The mesonotum of *communis* is extremely variable in colour. The pattern is similar to that of *pionips*, but the colour of the sides varies from grey to yellow to bronze, and the width of the central stripes is variable. The pattern is never so well defined as in *pionips*: the contrast between the markings is less, the lateral longitudinal half lines are often indistinct, the central line separating the two dorsal

TABLE I

Wing lengths and proboscis-wing ratios of *Aedes communis* (Deg.) and *Aedes pionips* Dyar.

Species	Number of specimens	Number of localities	Wing-length		Proboscis-wing ratio	
			range	average	range	average
communis ♀	100	11	3.52—5.37mm.	4.55mm.*	—	—
	48	9	—	—	0.57—0.76	0.68
pionips ♀	55	7	4.07—6.29	5.14*	—	—
	28	6	—	—	0.69—0.82	0.76
communis ♂	75	10	3.33—5.55	4.47	—	—
	62	10	—	—	0.64—0.86	0.75
pionips ♂	50	7	4.07—5.92	5.19	—	—
	33	6	—	—	0.71—0.84	0.78

*Difference necessary for significance at 1% level = 0.35.

1. Palpi and proboscis of *Aedes pionips* Dyar, ♂. 2. Palpi and proboscis of *A. communis* (Deg.), ♂. 3. Fore-tarsal claw of *A. pionips*, ♀. 4. Fore-tarsal claw of *A. communis*, ♀. 5. Claspette of *A. pionips*, ♂. 6, Claspette of *A. communis*, ♂. 7. First three right-prothoracic hairs of *A. pionips*, larva. 8. First three right-prothoracic hairs of *A. communis*, larva.

All specimens used in the preparation of these figures were taken at Yellowknife, N.W.T. Each pair of figures is drawn to the same scale.

stripes is much wider than in *pionips*, and the scales of the mesonotum seem to be more irregularly and loosely attached than in *pionips*.

The tarsal claws of *pionips* are a little more elongate than those of *communis* —the main claw continues for some distance beyond the tooth before it turns upward (Fig. 3). In *communis*, the main claw bends upward almost immediately beyond the tooth (Fig. 4). The shape in *communis* is slightly variable, but never like that in *pionips*. In females, the claws of all tarsi are of the same shape.

As body length of adult mosquitoes is very difficult to determine accurately, the wing length was used as a measure of size. Proboscis length was also determined, and the ratio of proboscis length to wing length was calculated. The figures obtained are summarized in Table I. "Student's" *t* test was applied to the measurement of wing length and a *t* value of 4.34 was obtained; as this far exceeds the 1 per cent level of significance, *pionips* may be considered a larger species than *communis*, though there is considerable overlapping in the actual lengths. The mean ratio of proboscis length to wing length is apparently higher in *pionips* than in *communis*, but, as with wing length, the overlap is so great that the proboscis—wing ratio is of little value in identifying specimens.

Males.—The claspette filament of *pionips* is distinctively angulate just beyond the base, and the filament is almost flat (Fig. 5). In *communis* the filament is gently curved in outline (Fig. 6), and when viewed from one end the top appears grooved because of a flange or wing along the outer side of the filament. Dyar (1928) figured the genitalia of both species, but his figure of *pionips* shows a

communis claspette filament, and vice versa. Edwards (1921) and Natvig (1948) figured the claspette filament of *communis* and mentioned the low wing running along the filament; their figures and descriptions apply very well to North American specimens.

The basal lobe of the basistyle of *pionips* has the posterior surface a little less concave than has that of *communis*. This difference is difficult to describe but the examination of a considerable number of specimens of each species indicated that a slight but constant difference in the shape of the basal lobe is associated with the difference in the shape of the claspette filament.

The most distinct difference between the males of the two species is in the palpi. In *pionips*, the palpi are slightly shorter than or subequal to the proboscis and are slender (Fig. 1). In *communis*, they are distinctly longer than the proboscis and the last segment is enlarged (Fig. 2); in pinned specimens this segment usually appears broad and flat. The palpi of Palearctic specimens of *communis* were figured by Martini (1931) [as *A. nemorosus*] and figured and described by Natvig (1948); they are apparently the same as those of Nearctic specimens of *communis*.

The mesonotal colour pattern and hind tarsal claws of the males resemble very closely those of the females of the same species. There seem to be no differences between the fore- and mid-tarsal claws of the males of the two species.

The wing lengths and proboscis-wing ratios of the males are summarized in Table I; neither seems to be of any value in identifying individual specimens.

Many of the differences are very slight and can be appreciated only if specimens of the two species are compared. This applies particularly to the shape of the tarsal claws, which is the most useful character for the determination of rubbed female specimens. The angle between the basal part of the claw and the upturned end must be carefully observed; if the base of the claw is obscured by scales the apical part may appear to turn up much more sharply than it actually does. It is often advantageous to press the tarsal claws flat on a slide so that they may be examined more readily. Because the differences between the females of the two species are comparativly slight, it is advisable to rear a series of specimens from larvae and to use them for comparison when determining adult specimens taken in the field.

The specimens studied were from a large number of localities in northern Canada. Specimens of both *communis* and *pionips* were available from White-horse and Dawson, Y.T.; Yellowknife and Fort Smith, N.W.T.; Gillam, Man.; Moose Factory, Ont.; Great Whale River, Fort Chimo, and Knob Lake, Que.; and Goose Bay, Labrador; of *pionips* from Fort Simpson, N.W.T.; and of *communis* from Reindeer Depot and Padlei, N.W.T.; and Harmon Field, Nfld. A female paratopotype of *pionips*, from White River, Ont., was readily identified as of *pionips* by means of the distinctions given above.

Summary
The morphological differences and one physiological difference between *Aedes communis* (Deg.) and *Aedes pionips* Dyar already noted in the literature are reviewed, and a number of further differences between the adults and larvae of the two forms are described. The large number of associated differences indicates that *pionips* is not a variety of *communis* but is a distinct species.

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The Teratoid Larva of Polyembryonic Encyrtidae (Hymenoptera)

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One very extraordinary phase in the development of certain polyembryonic encyrtids is the production of a precocious larval form. This anomaly appears while its normal sibs are still in an early embryonic stage of development, and although it leads an active parasitic life within the host it never succeeds in developing beyond the larval stage.

The existence of this aberrant larval form was first reported by Silvestri (1906) in *Copidosoma truncatellum* (Dalman), (*Litomastix*)[1] and he designated such forms as asexual larvae. He explained their origin on the basis of an early distinction of somatic and sexual cells; his theory was based on the fact that the germ cell determinant is not distributed throughout all the blastomeres during the early cleavage stages. Those cells receiving the germ cell determinant are temporarily retarded in their development, but eventually produce all the normal larval forms which Silvestri called sexual larvae. According to Silvestri's theory the blastomeres not receiving the germ cell determinant are then true somatic cells, and, since they divide more rapidly than the sexual cells, he believed that they produce the so-called asexual larvae. Silvestri believed that the asexual larvae of *C. truncatellum* were incomplete in their organic systems since he could not disclose the presence of gonads, malpighian tubules, nor respiratory and circulatory systems. Furthermore, he found that these larvae did not complete their development, but died within a few days.

The appearance of these asexual larvae is so much in contrast with the normal larvae of the brood that, lacking experimental or cytological evidence to the contrary, an examination of a host containing both sexual and asexual larvae would appear to be a clear case of multiple parasitism. In fact, this led Wheeler (1910) to interpret Silvestri's findings as follows: "First, the asexual larvae figured and described by this investigator are suspiciously like certain very young ichneumonid larvae, and as their development is not satisfactorily traced to the same cell-masses from which the sexual *Copidosoma* larvae arise, it is not improbable that the two larval forms really belong to two very different parasites. In other words, Silvestri's *Plusia* caterpillars were probably infested with ichneumonid

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[1] Synonymy as indicated throughout this paper is adopted from Muesebeck, C. F W., *et al.* (1951) Hymenoptery of America north of Mexico Synoptic Catalogue. U.S.D.A. Agr. Monogr. 2.

in addition to *Copidosoma* larvae. Second, I have been unable to find any larvae of the asexual type in a number of American *Plusia gamma* caterpillars which were heavily infested with *Copidosoma truncatellum*."

Patterson (1918) thus felt that the matter clearly needed a reinvestigation, and he undertook a study of the biology of *Copidosoma truncatellum*, (*Paracopidosomopsis floridanus*), a polyembryonic parasite of the common cabbage looper, *Autographa brassicae*. In controlled experiments in which all other parasitic species had been excluded, Patterson verified the existence of the asexual larvae and traced their origin back to their development in the young polygerms. Patterson concluded from a study of entire mounts and sections of asexual larvae that Silvestri was correct in his statement that a reproductive system was lacking. He did not determine whether the respiratory system, the circulatory system, and malpighian tubules were absent also.

Parker and Thompson (1928) studied the asexual larvae of *Copidosoma thompsoni* Mercet, and found that such a larva possessed a digestive system, but was deprived of circulatory and respiratory systems. They found that the larvae grew, but always seemed to die without transforming.

Leiby (1929) stated that in *C. thompsoni* the circulatory system is present, but the germ cells and respiratory system are wanting. He remarks, however, that the respective systems in such a larva are difficult to trace.

Doutt (1947) reported the presence of a precocious larval form in *Copidosoma koehleri* Blanchard which resembled the asexual larvae described by Silvestri. More recent work on this aberrant larval form has shown that it not only is produced soon after the host has undergone eclosion, but is an active parasite feeding on the host for a comparatively long period of time and does increase in size.

Although no tracheal system is visible and the precocious larva of *C. koehleri* is apparently apneustic throughout its life, it is obvious that such an active organism must respire and probably does so through its thin delicate integument. The larva thus closely resembles the first instar larvae of many other species of internal parasitic Hymenoptera which are known to rely upon cutaneous respiration. It would seem that although a tracheal system is lacking, nevertheless the larva is adapted to carry on respiration within its fluid environment.

Although no true adipose tissue is present in the teratoid larvae of *C. koehleri* there are aggregations of large fat cells dorsal to the midgut. These large spherical cells are also seen either free or grouped together in the larvae of *C. truncatellum* according to Silvestri (1906).

A well developed digestive system is present, for feeding begins shortly after the teratoid larva leaves the polygerminal mass. The midgut becomes packed and distended with food and develops a yellowish color. As with other internal hymenopterous parasites the larval midgut and hindgut have no functional connection during the feeding period.

The teratoid larva of *C. koehleri* is a very active organism and has a well developed musculatory system. Silvestri (1906) illustrates the same for *C. truncatellum*. It would thus appear from all the observations that these precocious larvae are not fundamentally different from many other larvae found among the parasitic Hymenoptera, and are complete in the essential organic systems. The presence or absence of germ cells in such an immature animal is too cryptic a character to be determined by the technique of gross dissections employed in this study. It seems debatable that the techniques of earlier workers could have

TABLE 1.

ASSOCIATION OF TERATOID LARVAE WITH FEMALE POLYGERMS

Progeny from	Hosts dissected	Hosts parasitized	Hosts containing teratoid larvae	Emerging Sex ratio
Virgin ♀ ♀	44	35	0	100% ♂ ♂
Mated ♀ ♀	28	25	21	49% ♂ ♂

demonstrated conclusively the presence or absence of gonads in such immature organisms.

Careful studies with *C. koehleri* have shown that the polygerms from unfertilized eggs never produce teratoid larvae, whereas the polygerms from fertilized eggs do (Table 1). This has been demonstrated many times in the past six years, but for the purpose of this paper an experiment was conducted using mated and virgin female parasites of the same age on host eggs which were uniform in age and stage of development. The resulting progeny of both types of females were reared under identical conditions and a random dissection of the two populations is recorded in Table 1.

Silvestri (1906) and Patterson (1918) believe that in *C. truncatellum* these curious larvae develop irrespective of whether or not the female parasite depositing the egg is virgin or impregnated. In view of the results obtained by careful handling of *C. koehleri* females it would seem that the matter needs reinvestigation in the case of *C. truncatellum*. The proved association of these anomalous larvae with only the female polygerm seems to cast considerable doubt on Silvestri's theory of their origin. Previously all students of polyembryonic encyrtids have been unable to detect any difference in the early development of polygerms from fertilized and unfertilized eggs. Consequently, the association of such larvae with the female polygerm only reopens the question of their origin. The term asexual larvae as coined by Silvestri does not seem to apply properly to the precocious larval forms found in *C. koehleri* and the adjective *teratoid* is suggested as being more descriptive of these aberrant organisms.

Although this study sheds no light on the true origin of these teratoid larvae, it is apparent that at least in the case of *C. koehleri* the entrance of spermatozoa into the ooplasm is necessary for their occurrence. It is possible that this precocious larval type arises in some manner from the portion of the egg in which the derivatives of the polar bodies are active. A considerable amount of cell division is apparent in the anterior portion or polar region of the egg before blastomeres are seen in the posterior or embryonic region. This has been reported by Silvestri (1906), Patterson (1918), and Doutt (1947) working with at least two different polyembryonic species, and it may be that the teratoid larvae which appear well in advance of the normal individuals, arise from this region of early, extensive, cell division.

Students of polyembryonic insects have speculated on the purpose and function of the teratoid larvae. Silvestri (1906) thought that they might be simply abortive forms without special function and destined finally to perish, but in considering various aspects of their morphology he felt it more likely that they served to penetrate and lacerate host tissue in order that it would be more available to the normal larval forms. He further compared the dimorphism in *C. trunca-*

tellum larvae to the polymorphism of social insects. He believed in *C. truncatellum* which produces many hundreds of individuals from a single egg, it was possible that a special form or caste had been developed of great usefulness to the species. Patterson (1918) could find no evidence that these larvae served any special function. Parker and Thompson (1928) felt that these larvae were simple monstrosities with no significance in connection with the well being of the species. The writer is also inclined to concur in this viewpoint.

Observations of the teratoid larvae of *C. koehleri* indicate that they feed together with the normal larvae and remain active until a few hours prior to the pupation of the normal brood. The mortality of the teratoid forms appears to be due to their lack of ability to adapt themselves to the environment as it changes from a fluid to a drier condition. The failure of the teratoid larvae to develop a tracheal system thus probably accounts for their inability to survive in a host whose internal organic systems are finally consumed at a very rapid rate by the normal hymenopteriform larvae of the brood.

Summary

The aberrant and precocious larval form peculiar to certain polyembryonic species is produced only from polygerms of the female sex in *Copidosoma koehleri*. This association casts some doubt on the validity of Silvestri's theory of their origin and the name teratoid larvae is suggested as being more appropriate than the term asexual larvae as proposed by Silvestri. The failure of these larvae to mature is attributed to their inability to adapt their respiratory structure to a rapidly changing environment.

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Two New Species of *Dikraneura* from Western Canada, with Notes on Other Species (Homoptera: Cicadellidae)[1]
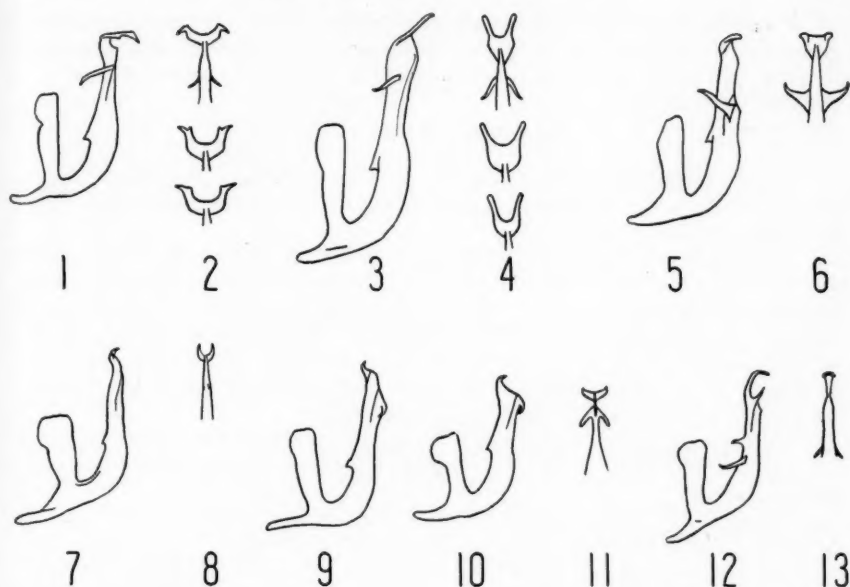
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The following are descriptions of two new species of leafhoppers of the genus *Dikraneura* from Western Canada. Notes on other species found in that region are appended. Two of the latter, *rubrala* DeL. & C. and *rufula* Gill., have apparently not been recorded previously for Canada. Figures of the aedoeagi are provided, as this structure normally provides the only reliable specific characters and must be examined if specific identifications are required. The name *Dikraneura* is used here in the restricted sense, following Oman (1949),

Figs. 1-13. *Dikraneura* spp. Lateral view of aedoeagus and ventral view of tip of aedoeagus of: 1, 2, *D. rubrala* DeL. & C.; 3, 4, *D. ossia* n. sp.; 5, 6, *D. feirde* n. sp.; 7, 8, *D. absenta* DeL. & C.; 9, 10, 11, *D. carneola* (Stål); 12, 13, *D. rufula* Gill.

rather than in the broad sense of DeLong and Caldwell (1937), Beamer (1943), and others.

Dikraneura ossia n. sp.
Figs. 3, 4

Length 3.0-3.4 mm. General colour yellow, sometimes faintly tinged with brownish on vertex on either side of mid-line and on disc of pronotum. Abdomen black with the posterior margins of the segments pale.

Aedoeagus expanded at apex as a flattened plate of which the apical angles are produced as slender, digitate processes; shaft with a spine arising from each side near apex and directed outward, downward, and forward, and with two short projections arising from a common base on the anterior (dorsal) margin at a point about a third of the length of the shaft. Pygofer with an upwardly directed, curved spine arising from an expanded, flattened base. Style with apical region roughly triangular, with a short, curved, dorsal apical spine and a small, blunt, ventral apical process. Seventh sternite of female with the posterolateral corners broadly rounded.

This species shows close relationship to *rubrala* DeL. & C., from which it can be distinguished readily by the form of the aedoeagus, particularly of its apical region. In *rubrala* the apical processes of the apical plate are directed outward, and each has a short spine or projection on its inner (posterior) margin (Fig. 2), whereas in *ossia* the processes are simple and are directed posteriorly. Moreover, this species lacks the rose-red markings of the vertex, pronotum, and fore wings that are present in *rubrala*.

Holotype.— ♂, Birch River, Manitoba, August 3, 1937 (R. H. Beamer). In the collections of the Snow Entomological Museum, University of Kansas.

Allotype.— ♀, same data as holotype.

Paratypes.—2 ♂ and 2 ♀, same data as holotype; 1 ♂, Saskatoon, Saskatch-
ewan, May 17, 1926 (K. M. King); 1 ♂, Saskatoon, Saskatchewan, August 8, 192–
[year not given on data label] (K. M. King); 1 ♂, Mafeking, Manitoba, August 3,
1937 (R. H. Beamer).

Dikraneura feirde n. sp.

Figs. 5, 6

Length 3.4-3.8 mm.   General colour pale yellowish, sometimes faintly tinged
with brownish on the vertex and pronotum, the fore wing sometimes with a faint
brownish suffusion at apex.

Aedoeagus with a roughly triangular, flattened, apical plate, the apical
corners of which are bent downward (posteriorly); shaft with a flattened,
tapering spine arising from each side beyond middle, and with a pair of short,
pointed processes arising from the anterior (dorsal) margin before middle.
Pygofer with posterior margin produced as an upwardly directed, curved spine.
Style with apical region roughly triangular, with a blunt, curved, dorsal apical
spine and a small, rounded, ventral apical process.

The form of the aedoeagus is distinctive.   Judged from the figures given by
DeLong and Caldwell (1937), the species is perhaps related most closely to
arizona DeL. & C.

Holotype.— ♂, Summerland, British Columbia, September 10, 1931 (A. N.
Gartrell).   No. 5994 in the Canadian National Collection.

Paratypes.—1 ♂, Chilcotin, British Columbia, July 29, 1920 (E. R. Buckell);
1 ♂, Oliver, British Columbia, May 23, 1923 (C. B. Garrett); 1 ♂, N. P. Mine,
Hedley, British Columbia, August 7, 1934 (A. N. Gartrell).

Notes on Other Species

Dikraneura carneola (Stål) (*sitkana* Ball & DeL., *shoshone* DeL. & C.) (Figs.
9-11).—The internal genitalia of the holotype male, collected at Sitka, Alaska,
and now presumably in Stockholm, Sweden, do not seem to have been examined.
Consequently it is not definite that the *carneola* of American authors is the
carneola of Stål.   There appear to be two forms that differ from each other
slightly, but apparently constantly, in the shape of the aedoeagus.   One has the
apical margin of the aedoeagus more oblique, with a definite rounded projection
below the bases of the apical processes (Fig. 9).   Specimens of this form from
Summerland, British Columbia, and from localities in Oregon, California, Colorado,
and Utah were examined.   The other has the apical margin of the aedoeagus
more nearly straight and more nearly at right angles to the shaft (Fig. 10).
Specimens of this form from Brandon, Manitoba; Saskatoon, Saskatchewan;
Manyberries, Alberta; and Soda Creek and Chimney Creek, British Columbia,
were examined.   Because of the individual variation that occurs in this species,
it is best not to regard the differences between the two forms as of specific
significance.

Dikraneura rubrala DeL. & C. (Figs. 1 & 2).—Specimens from Swan River,
Manitoba, were examined.   The species has apparently not been recorded previ-
ously for Canada.

Dikraneura rufula Gill. (Figs. 12 and 13).—Specimens from Victoria, British
Columbia, were examined.   The species, which was described from specimens
collected in California, has apparently not been recorded previously for Canada.

Dikraneura absenta DeL. & C. (Figs. 7 and 8).—This appears to be a common
species in parts of British Columbia; specimens from Summerland, Duncan, and
Victoria were examined.

Acknowledgments

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Two New Species of *Colladonus* from British Columbia (Homoptera: Cicadellidae)

By W. Downes

Colladonus arctostaphyli n. sp.

Length (male and female) 4.5 mm. Width 1.2 mm. Face slightly convex, vertex pointed, slightly more than right angled, 1½ times wider between the eyes than length at middle line. Pronotum twice as wide as long. Male plates spoon-shaped, curving upward at the tips. Female seventh segment evenly rounded at the sides, broadly excavated at the centre, with the usual strap-shaped projection, at the tip of which is a small V-shaped notch.

Colour: in fresh specimens, vertex pale yellow or ivory, transversely suffused with cinnamon brown, often leaving a pale cruciate mark at the tip. In many specimens there is a pale cinnamon band on the margin of the vertex. Clypeus pale cinnamon with six narrow brown arcs broken on the centre line. Eyes bright red. In specimens more than two years old the bright red colour changes to brown. Anterior border of pronotum yellow, remainder yellowish white. Scutellum yellow; in some males there are two dark triangular spots at the basal angles and two small round spots in the centre. Wings hyaline, veins yellow, the colour more pronounced in the claval veins. ·Apical cells distinctly outlined with brown. Tergum and venter black, margins of segments yellow. Legs ivory. Sternite VII of female and tips of male plates white.

Described from numerous specimens taken on the host plant *Arctostaphylos tomentosa* Dougl. on Malahat Mountain near Victoria, B.C.

Holotype male and allotype female, Malahat, B.C. August 18, 1950 and 20 paratypes.

Colladonus atriflavus n. sp.

Length (female) 5.5 mm. Width 1.3 mm. Form slender. Face slightly convex. Angle of vertex slightly more than a right angle; vertex twice as wide as long, the apex rounded. Pronotum twice as wide as long with indistinct transverse striations, the posterior margin straight. Female seventh segment twice as long as the sixth, excavated on the middle third, with a rather short ligulate projection without a notch at the tip. Colour: general appearance black and yellow. Vertex, face and entire ventral surface pale yellow; eyes yellowish green; pronotum, scutellum and clytra dark brown or black, merging into brown on the distal portion of the elytra. Costal area hyaline. A hyaline spot at each end of the central ante-apical cell. Apical portion of the clytra embrowned. Two small white chevrons on the commissural line. Tergum black, legs pale yellow. Described from four females. The only male examined is a specimen collected at Vancouver by the late K. F. Auden September 9, 1923, which is too badly damaged for use as a type. It has the vertex more rounded than in the female. Holotype female, Malahat, B.C., September 19, 1950 and three paratypes.

This is a rare species, only five specimens having been collected in the last thirty years. Four of these were swept from *Spiraea douglasii* Hook, which may be the host.

Observations on the Biology of Mosquitoes (Diptera: Culicidae) at Goose Bay, Labrador[1]

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Introduction

The program of biological studies and experiments in chemical control of mosquitoes at Churchill, Manitoba, in 1947 and 1948 (Twinn et al., 1948; Twinn, 1950) was extended in 1949 to include Goose Bay, Labrador. The program at Goose Bay was primarily designed to develop control measures for the northern species of biting flies. Since the control experiments were scheduled for definite periods during the summer in 1949 (Twinn et al., 1950), limited biological studies were carried on as circumstances permitted. These field studies produced information on the species of mosquitoes present and their development and ecology. Data obtained in 1949 from field observations, collections, identifications of adult and immature forms, and limited laboratory rearings are summarized in this paper. Additional data obtained by officers of the Division of Entomology in 1950 under similar circumstances have been included, in some cases as confirmation of observations in 1949.

Accurate descriptions of the mosquito species are not yet possible owing to the difficulty of distinguishing some of the black-legged species in the adult female form. Wild-caught females in this group have so many variations and intergradations in the morphological characters used in identification that some of the mosquitoes can only be described as complexes involving two or more species. In 1949 an attempt was made to rear mosquito larvae in an insectary after they had been taken from pools in the field. Mortality of immature forms was so high, possibly as a result of contamination from the control program and of the inadequacy of improvised insectary facilities, that the information obtained from these rearings was in some cases insufficient to help solve the complexities in the taxonomy of adult females of the black-legged species. However, all species represented were identified without difficulty in the larval form.

The Species Present

In 1949, 20 species of Culicidae were found in the Goose Bay area (Table 1). Of these, 17 were culicine and three chaoborine. The black-legged species *Aedes communis* (Deg.), *A. punctor* (Kby.), *A. implacabilis* (Wlk.), and *A. pionips* Dyar were identified as fourth-instar larvae, but wild-caught females showed so much variation and intergradation that only a portion of the adults could be identified to species; the others were separated into groups of species. *Aedes intrudens* Dyar, *A. flavescens* (Müller), and *A. diantaeus* H., D., & K. were found in such small numbers that they should not be included in the group of major pest species for this area. The last two species were taken only in the larval form.

Collections in 1950 generally confirmed the species collected in 1949. However, one additional species was found, namely, *Culiseta alaskaensis* (Ludl.). Only three females of this species were collected and no larvae were found.

The dates of the various species collected in 1949 are shown in Fig. 1. The relative populations indicated are based on the frequency with which adult females were captured in nature, and are therefore approximate. Since the complexities of identification of adults of the *A. communis*, *A. punctor*, and
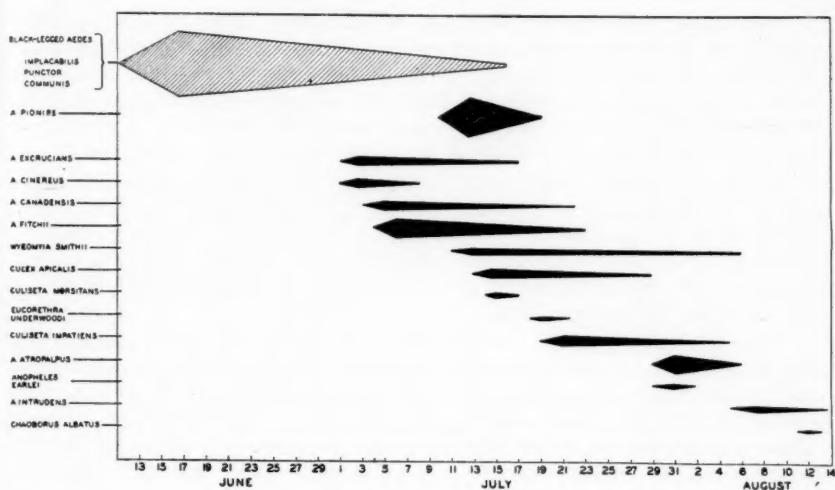
Fig. 1. Succession and relative abundance of adult mosquitoes of various species; Goose Bay, June, July, and August, 1949.

TABLE I

Mosquitoes Collected as Larvae at Goose Bay, Labrador, in 1949, with Data on Adults.

Species	Adults		Species	Adults	
	Reared	Overwintered		Reared	Overwintered
Culicinae			*A. flavescens (Müller).......		
Culicini			*A. diantaeus H., D., & K....		
A. communis (Deg.)...	x		Culex apicalis Adams.......	x	x (June 12)
A. punctor (Kby.).....	x		Wyeomyia smithii (Coq.)....	x	
A. pionips Dyar......	x		Culiseta morsitans (Theo.)...	x	
A. excrucians (Wlk.)..	x		C. impatiens (Wlk.)........	x	x (May 17)
A. cinereus Meig......	x		Anophelini		
A. canadensis (Theo.).	x		Anopheles earlei Vargas......	x	x (June 11)
A. fitchii (F. & Y.)....	x		Chaoborinae		
A. atropalpus (Coq.)..	x		Eucorethra underwoodi Und...		
*A. intrudens Dyar....	x(?)		Chaoborus albatus Johnson...	x	
A. implacabilis (Wlk.).	x		Mochlonyx cinctipes (Coq.)...	x**	

*Species that were present in very small numbers.
**From pool emergence cage.

A. implacabilis group made it impossible to show the emergence and the relative populations of distinct species, all three species were included in a single group. However, the dates of emergence of the groups and the presence of identified larvae clearly indicate that adults of *A. pionips, A. communis, A. implacabilis,* and *A. punctor* were present in large numbers. Further work in the systematic rearing of certain species is desirable for accurate separation of the females.

Samples of adult female mosquitoes captured in 1949 indicated that 36 per cent of those attracted to man belonged to the black-legged group comprising *A. punctor, A. implacabilis, A. communis,* and *A. pionips.* Approximately 23 per cent of this group were reliably identified as *A. pionips.* The black-legged group was followed in numbers by *A. fitchii* F. & Y., which represented 10 per cent of all the wild-caught females.

Five species were found to overwinter in the Goose Bay area as adults. Four of these were represented by overwintering females captured early in the season, namely, *Anopheles earlei* Vargas, *Culiseta impatiens* (Wlk.), *Culiseta alaskaensis,* and *Culex apicalis* Adams (Table I). The fifth species, *Culiseta morsitans* (Theo.), was collected in the immature form and reared to the adult. No immature forms of *Anopheles earlei* were obtained to allow rearing. *Wyeomyia smithii* (*Coq.*), which overwinters in the larval form, was observed in the leaves of *Sarracenia purpurea* L. throughout the summer. Even when temperatures were near the freezing point and ground pools were still covered with snow and ice, the larvae were observed to be active in the taller, pitcher-shaped leaves that were exposed sufficiently to the sun during the day to have their contents thawed completely or in part. Extensive sampling of *S. purpurea* leaves on June 12-13, 1949, gave an average of more than four larvae per leaf.

Notes on the Species

Aedes communis (Deg).

This is typically a forest species. The larvae and pupae were found in sheltered areas in pools of various sizes and depths. The immature forms tolerate a wide range of p^H (4.5 to 7.5) of water in the breeding pools. Consequently the pools varied from the clean, mossy-bordered type in thick spruce forests to the mucky, sediment-suspending, grassy-bordered pools in willow swamps. The latter type of pool was usually dark brown with decaying leaves and other organic matter. The larvae had reached the fourth instar on June 9, in 1949, in the willow-swamp habitats, and on June 25 in the spruce forest pools; the difference was apparently a direct result of the difference in the amount of shade from solar heat for bottom ice persisted longer in forest pools. Emergence of adults in significant numbers began on June 12, in 1949, in the more exposed type of pool, whereas in the others it was about 10 days later. This species, together with *A. punctor, A. implacabilis,* and *A. pionips,* was apparently responsible for most of the discomfort experienced in the R.C.A.F. camp area, since the emergence of these mosquitoes and the worst mosquito invasion of the Air Force base occurred simultaneously. The black-legged group of mosquitoes comprised the major infestation of inhabited areas during the latter part of June and the first week in July. With the decline in numbers of this group, comfort in the camp increased, although other species, such as *A. fitchii,* were just reaching the peak emergence period. The chief predator of *A. communis* in the murky, turbid type of pool was *Eucorethra underwoodi* U. Although Coleoptera and Odonata were the chief predatory groups in most pools, they did not show tolerance to environmental conditions in the mucky, dark pools sometimes chosen by *A. communis.*

Aedes punctor (Kby.)

In the Goose Bay area, the larvae and pupae of *A. punctor* were found most frequently in open, grassy pools exposed to sunlight, in small clearings surrounded by willow or spruce thickets. The species was one of the more numerous along the shore of Terrington Basin, where it frequently inhabited the small, shallow snow pools on the open, grassy beach. The species showed less tolerance for a wide range of p^H (4.5-6.0) than *A. communis* and was found in small numbers in the extremely turbid pools in which *A. communis* so often seemed to thrive. The emergence period of *A. punctor* almost coincided with that of *A. communis* for the willow-swamp habitat. The larvae were associated principally with *A. communis*, *A. pionips*, *A. implacabilis*, or *A. fitchii*, depending on the type of pool.

Aedes pionips Dyar

This species was one of the first to appear in the larval form; fourth-instar larvae were found in large numbers by July 9, in 1949. Although often associated with *A. punctor* and *A. communis*, this species was more restricted in its breeding places. Regardless of the site, wether in open bog, on grassy beaches, or in spruce forest, the pool characteristics were rather uniform. A loose, mucky bottom of black humus and rotting wood appeared to be characteristic. The pools were always shallow, usually small, and of a semi-permanent nature. Semi-permanency of the pools usually depended on their location in the seepage bed of boggy swamps, near the water level of lakes, along beaches, or beside streams flowing through spruce forests. Typical *A. pionips* pools showed slight growth of low vegetation, such as grass, mosses, and willows.

The females of this species began to emerge on June 12, in 1949, but the wild-caught specimens were apparently part of a variable group in which some could not be reliably separated from others exhibiting many of the morphological characters used for *A. communis* in taxonomic keys (Matheson, 1944; Natvig, 1948). A later brood that began to emerge on July 11, in 1949, was reliably identified as of *A. pionips* and lacked the confusing intergradation of morphological characters.

Aedes implacabilis (Wlk.)

This species was associated in the immature stages with *A. punctor*, although the latter was not always associated with *A. implacabilis*. The larvae appeared with *A. punctor* in clean, sphagnum-filled, shallow pools in open, boggy swamps. Development and emergence coincided with those of *A. punctor* and *A. communis*. It is possible that the adult females formed part of the complexes that comprised the black-legged group of mosquitoes and were not recognized as adults of this species.

Aedes cinereus Meig.

The larvae were usually found in both wooded and open areas, in small, shallow puddles formed by the melting of snow. In wooded areas the pools were always well filled with decaying leaves with an inch or two of water above them. In open areas, pools contained thickly matted masses of both decaying and growing grass. Fourth-instar larvae were observed at the end of the first week in July in the forest areas, but in the exposed, grassy type of pool they appeared on June 25. Presence of adults indicated emergence as early as July 1.

Aedes atropalpus (Coq.)

Immature forms appeared in pools in depressions in the bare rocks along the margins of rapids and waterfalls of rivers and streams. In these pools the water

supply was continually replenished by the spray from the turbulent waters, and by rain. Significant numbers of adults did not appear until July 19, in 1949. They were a nuisance as biters only in the vicinity of their breeding places. The heaviest infestation observed in the Goose Bay area was at Muskrat Falls on the Hamilton River, where large numbers of larvae occurred in small rocky crevices containing as little as a quart of water. The females caused considerable discomfort by their persistent biting near the falls. There is probably a high mortality of the immature stages when the pools dry up during the summer. However, since larvae were observed throughout most of the summer, there may be several generations or broods each summer. Development is probably rapid, since pool temperatures during the day rise quickly and remain high until the evening.

Aedes fitchii (F. & Y.)

This species formed approximately 10 per cent of the total mosquito population and was second in abundance only to the species included in the black-legged group. It is a persistent biter in thickly wooded areas but, unlike *A. communis*, *A. punctor*, and *A. canadensis*, it is rarely found in inhabited areas and no specimens were reported captured inside buildings. Larvae were found in a variety of pools both in wooded swamps and in open sphagnum bogs. Fourth-instar larvae appeared at the end of June and general emergence took place about July 6. *A. punctor* and *A. cinereus* were the only species found associated in the larval stage with *A. fitchii*; the former was found with *A. fitchii* in sphagnum bogs, and the latter in grassy woodland pools.

Aedes canadensis (Theo.)

Larvae of this species were found in large grassy pools filled with decaying willow leaves; they had reached the fourth instar by July 4, in 1949. The pools were semi-permanent because of their proximity to streams or larger bodies of water. The species was also observed in the slow-flowing water of ditches and in ruts made by military vehicles. In almost every instance the larvae were associated with *Culiseta morsitans*.

Other species

All other species collected in the Goose Bay area, including *Aedes excrucians* (Wlk.), *A. intrudens*, *A. flavescens*, *Aedes diantaeus*, *Culiseta morsitans*, *Culiseta impatiens*, and, *Anopheles earlei*, either appeared in too small numbers or, if abundant, were not sufficiently attracted to man to be classed as serious pests. The latter group includes *C. morsitans*.

Ecological Observations

The combination of chemical control experiments and biological studies in one program is at cross-purposes in many respects. However, the daily checks performed for the control experiments provided significant ecological information on the forest species in the area. Indications of ecological limitations of some of the sub-arctic forest species were also obtained in habitat studies.

In the biological phase of the 1949 program, a number of classified observation stations was selected in representative areas within six miles of the Goose Bay base. Intensive studies were limited to approximately 100 sq. mi. lying principally between the Goose and Hamilton rivers and Terrington Basin. The R.C.A.F. base occupies the hub of this area on a level, sandy plateau of delta formation 75-100 ft. above water level between the two rivers. The plateau itself is relatively dry, with sparse growth of small black spruce, lichens, and mosses. Toward the river on the north, east, and south, the plateau falls off suddenly to swampy flood plains comprised of better-drained, thickly wooded
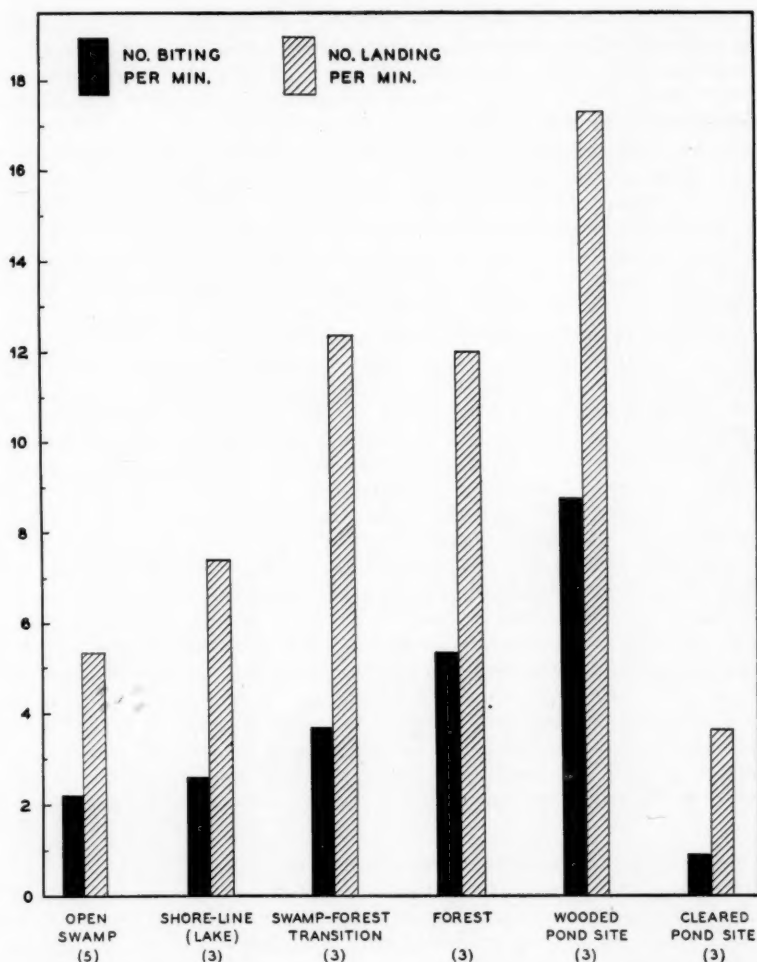
Fig. 2. Average biting and landing rates of mosquitoes under various ecological conditions, Goose Bay, June 15-Aug. 15, 1949 (number of sites in parentheses).

parts and scattered floating bogs varying from one-half to three and one-half miles in breadth. The low flood plains surrounding the sandy plateau provide the breeding places for the forest species of mosquitoes.

The development of installations at the base has made the Goose Bay area unique as a site for biological studies. During the construction of the base in 1942 certain areas were stripped of timber, especially in the Hamilton River valley. Some of these areas were included in the station sites for biological studies.

For biological comparison the station sites were grouped ecologically as follows: open swamp; shore-line; swamp-forest transition; forest; forest pond; and cleared pond. It was assumed that the attracted populations of mosquitoes

were reasonably indicative of the unattracted populations. Therefore, standard biting rates and landing rates were used as an index of the mosquito populations at the station sites. Since comparative values used were long-term averages for periods of stable weather, they were not influenced significantly by changes in meteorological conditions.

Average populations for classified habitats in the flood plain area at Goose Bay in 1949 are shown in Fig. 2. The relation of mosquito populations to the presence or absence of forest growth is apparent. The graph provides some evidence of the rather short range of dispersal of the forest species of mosquitoes. These species, with three exceptions, were generally observed to remain either within or at the perimenters of heavily wooded areas. The decided decrease in mosquito populations in deforested areas is further evidence of the ecological limitations on the distribution of the forest species in the Goose Bay area. The topography, abundance of natural pools, drainage, surface vegetation, and soil characteristics of station sites in both the cleared and the forest areas were identical. The only difference was the amount of forest cover. There are indications, therefore, that the complete clearing of forest growth within a mile or more from the perimeter of camp sites considerably decreases the mosquito populations in the vicinity of the camps. Systematic sampling indicated that the absence of forest habitat significantly decreased the numbers of the three species, namely, *A. communis*, *A. punctor*, and *A. canadensis*, observed and captured in the camp areas, although, unlike the other species, they apparently dispersed short distances from their breeding places under favourable meteorological conditions. Permanent residents and fur-traders at Goose Bay reported observing a gradual, annual decrease in mosquito populations in the immediate area of the base as the camp facilities were extended and wooded areas were cleared. Severe infestations of mosquitoes were usually present in the timber stands still remaining. *Culex apicalis* breeds in large numbers in the small pools and ponds in the areas stripped of forest but this species is not known to attack man. Sufficient forest growth still remained near the camp to provide habitats for large numbers of the mosquitoes, which caused discomfort in the camp area when wind conditions were favourable for mosquito flight.

Comparative Importance of the Species

In field studies in which large numbers of females of the black-legged species of *Aedes* were captured while landing or biting, it was difficult to separate specimens to species. Consequently, comparative âbundance of these species could be established only approximately from the numbers of females captured. During a series of 24-hr. checks in 1949, the samples of female adults of the black-legged group that was principally responsible for the infestations that caused serious discomfort in the camp area were divided into two intergrading complexes. Systematic sampling was conducted during the first three weeks of July. The most abundant complex on the basis of identified captured females appeared to be that including *A. communis* and *A. pionips*. The other complex, including *A. punctor* and *A. implacabilis*, was almost equal in abundance and may have been greater during the latter part of June. The peak emergence of *A. communis* occurred slightly later than that of *A. punctor* and *A. implacabilis*, and a marked difference in specific abundance would be expected from the last week of June to July 15. All specimens in the second group appeared to be of *A. punctor*, but it is certain that a large portion of them were of *A. implacabilis* that could not be separated in the adult female form. Sampling of larval populations indicated that significant numbers of *A. implacabilis* should have been present.

Random collections of larvae from 63 sites from June 1 to 17, 1949, contained the following species in the percentages indicated: *A. implacabilis*, 60; *A. punctor*, 26; *A. communis*, 14. Forty-eight per cent of the collections contained larvae of *A. implacabilis*; 43 per cent, *A. punctor*; and 9 per cent, *A. communis*. This sampling of larvae did not include extensive sampling in the more inaccessible forest habitats. Pools formed by delayed melting of ice under dense forest cover contained larger numbers of *A. communis* larvae slightly later in June, and smaller numbers of *A. pionips* and *A. fitchii*. The latter two species were not collected in the camp area during or after the serious invasions by mosquitoes from adjacent forest habitats that occurred under favourable meteorological conditions. The species that were pests in the camp included *A. communis*, *A. punctor* (possibly with *A. implacabilis*), and *A. canadensis*. All the other species were found only in the wooded areas that provided suitable habitats.

The 24-hr. studies of mosquito activity were conducted under comparable meteorological conditions as far as possible. They were taken at approximately the same distance from the base but in different directions from the centre. Fig. 3 shows the numbers of the most abundant four species of specific groups biting in the Goose Bay area, as recorded at Alexander Lake, four miles to the west of the base in unsprayed terrain, on July 24-25, 1949. Other 24-hr. surveys showed similar results. The biting rates shown in Fig. 3 were obtained by collecting the mosquitoes with a killing bottle as they commenced to bite on a bare forearm. Although it was impractical to collect more than 30 mosquitoes per minute, all those biting were counted; for the higher biting rates, this sample was large enough to permit a reliable estimate of the proportions of the species. Under normal weather conditions mosquitoes increased their biting activity to
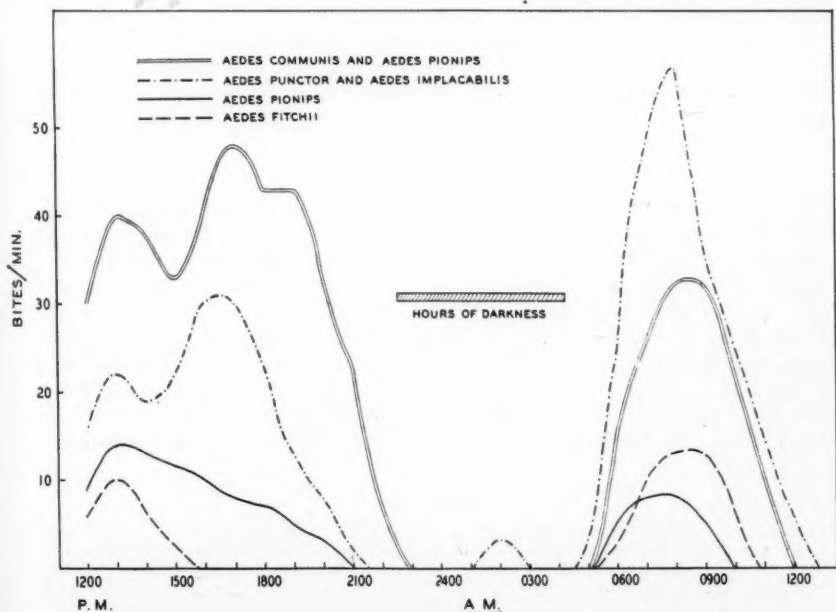

Fig. 3. Comparison of biting rates of species of mosquitoes at Alexander Lake, Goose Bay, during a 24-hr. survey, July 14-15, 1949 (see text).

nuisance proportions between 5 a.m. and 10 p.m. Toward midnight and through the early morning there was usually only limited activity, unless the normal behaviour of the mosquitoes was influenced by air disturbances resulting from the passage of fronts within existing weather systems. During the 24-hr. studies there was total darkness approximately from 10.30 p.m. to 2.30 a.m.

A. excrucians, A. cinereus, A. canadensis, A. atropalpus, and *A. intrudens* were present only in small numbers in the Goose Bay area, where they were collected occasionally in the forest. *A. atropalpus* occurred only near its breeding places in rock pools. *Culiseta morsitans* was present in significant numbers, but was not persistent in attacking man. *C. impatiens* and *Anopheles earlei* were collected rarely.

Three species of Chaoborinae were found to be predatory on mosquito larvae. *Eucorethra underwoodi* was the chief predator of *A. communis* in the turbid type of pool, in which both occurred. *Chaoborus albatus* was present in too small numbers to be significant as a predator. *Mochlonyx cinctipes* was an important predator of the larvae, especially of the later species, such as *A. excrucians, A. cinereus, A. canadensis, A. fitchii,* and *C. impatiens.* In pools under observation the numbers of *M. cinctipes* increased from the middle of June to the end of July.

Although large numbers of larvae of *Culex apicalis* were observed in certain pools, no adults were captured on man and they were rarely collected by sweeping even near their breeding places.

Summary

At Goose Bay, Labrador, in 1949 and 1950 in conjunction with experimental airsprays, 21 species of Culicidae, 18 of Culicinae and 3 of Chaoborinae, were collected. The Culicinae comprised 12 species of *Aedes,* three of *Culiseta,* one of *Culex,* one of *Wyeomyia,* and one of *Anopheles*; the Chaoborinae comprised one species each of *Eucorethra, Chaoborus,* and *Mochlonyx.* It is difficult to identify the females of forest species of black-legged *Aedes* spp. that occur in the sub-arctic. Data on dates of emergence and species abundance are presented. The ecology, the development, and the comparative importance of the various species at Goose Bay are discussed.

Acknowledgments

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COMMITTEE ON COMMON NAMES OF INSECTS

The following committee on the common names of insects has been appointed by the Entomological Society of Canada and the various regional entomological societies:—

A. D. Pickett, Chairman, Kentville; M. E. Neary, Truro; W. A. Reeks, Fredericton; A. A. Beaulieu, St. Jean; W. J. Brown, Ottawa; R. H. Wigmore, Secretary, Ottawa; H. W. Goble, Guelph; W. P. Stephen, Brandon; A. P. Arnason, Saskatoon; C. L. Neilson, Vernon.

As a basis for recommending changes in or additions to the official list, members of the various regional societies are invited to make suggestions as soon as possible to their representatives on the Committee.

A. D. PICKETT, *Chairman*   R. H. WIGMORE, *Secretary*

CORRECTION

Insert, p. 142 ("New North American Muscoid Diptera" by H. J. Reinhard) below line 41: "Holotype male and allotype female, College Station, Texas, May 9, 1945 (H. J. Reinhard). Paratypes: 21 males and 10 females, same locality as type, April to July, 1945-47 (H. J. Reinhard); and 2 males, Amherst, Ohio, July, 1933 (H. J. Reinhard)."

LAWSON CAESAR
1870 - 1952

Professor Lawson Caesar died suddenly at his home at Guelph, Ontario, on April 27th, 1952. He had been in good health and his sudden death was a great shock to his many friends.

Professor Caesar was born at Mono Road, Ontario, on February 15th, 1870. He was graduated from the University of Toronto in 1895. Following graduate work at the University of Oxford he taught classics in Ontario High Schools for several years.

Early in life Professor Caesar had developed a keen interest in nature and this finally led him to enter the Ontario Agricultural College in order to major in entomology.

Following his graduation in 1908 he joined the staff of the Department of Entomology and Zoology of the Ontario Agricultural College and here he continued in active service until his retirement in 1940. As Provincial Entomologist and Professor of Economic Entomology Professor Caesar not only directed the regulatory work in entomology for the Province but was in charge of research and extension in the applied field and also administered the courses in economic entomology of his department. During his time of service all this was expanded greatly. Professor Caesar personally carried out an extended programme in applied entomology. Much of this was pioneer work for his Province. It is especially worthy of note that he began the present spray service for fruit growers of the Province. He was the author of many bulletins and papers on the biology of insects and their control.

Results of Professor Caesar's work were always available to others. He had, accordingly many appreciative friends amongst the workers in entomology throughout Canada and the United States. Evidence of this appreciation lies in his election to the presidency of the Entomological Society of Ontario and the vice-presidency of the Entomological Society of America.

Many workers in entomology owe much to Professor Caesar not only for the contributions which he made but, also, for the inspiration and help which they received personally from him—either as students or co-workers.

As a man and a colleague Professor Caesar endeared himself to all with whom he came in contact. His kindly nature, his quiet sense of humour and his sincere desire to be of help to any and all made him much beloved. He was a professing Christian who practised his profession. There are many who would bear testimony to this.

Professor Caesar kept up his interest in entomology to the end and frequently visited his old department to discuss current problems in the insect world. He will be missed greatly. A. W. BAKER

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